



Potential Restoration Projects for Natural Resources Impacted by the Morris J. Berman Oil Spill San Juan National Historic Site and Nearby Areas along the North Coast of Puerto Rico: Project Summaries

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1. INTRODUCTION AND INCIDENT BACKGROUND

On January 7, 1994, the *Morris J. Berman*, a barge, loaded with 1.5 million gallons of no. 6 fuel oil, drifted aground near San Juan, Puerto Rico, after its tow line from the tug *Emily S.* broke. The barge grounded on a reef near Punta Escambron, which ruptured some of the holding tanks and released

approximately 800,000 gallons of fuel oil into nearshore waters including those adjacent to the San Juan National Historic Site. Figure 1-1 shows a map of the grounding site and surrounding area. On January 15, 1994, after lightering most of the remaining oil, the U.S. Coast Guard refloated, transported, and then scuttled the barge in about 6,100 feet of water about 20 nautical miles north-

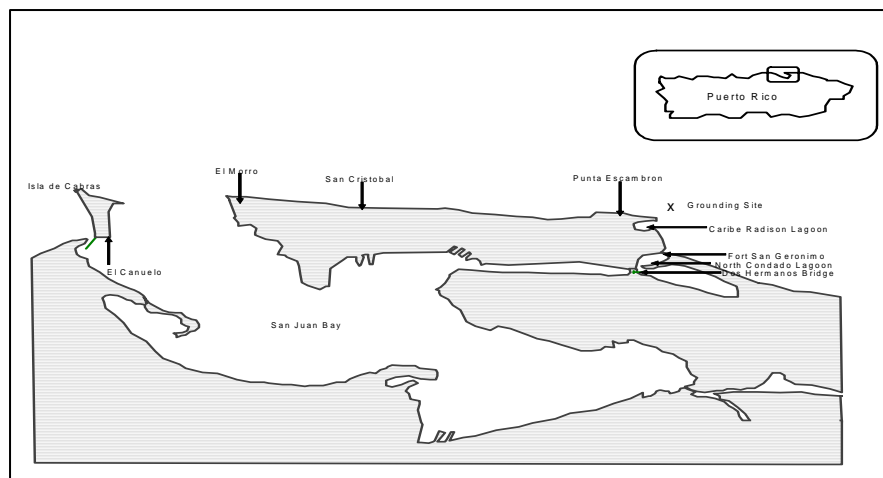


Figure 1-1. Grounding Site and Surrounding Area

northeast of San Juan. It was estimated that a secondary release of up to 125,000 gallons of an oil/water mixture occurred during removal operations. The released oil eventually spread along much of the northern and northwestern coast of Puerto Rico, injuring resources along the shoreline.

The National Oceanic and Atmospheric Administration (NOAA), the National Park Service (NPS), and the Puerto Rico Department of Natural and Environmental Resources are the natural resource Trustees for this incident. Their duties include planning and implementing appropriate restoration projects. The Trustees identified potential projects to address injuries that occurred to reach an agreement on the amount of monetary damages. A settlement agreement reached on December 28, 2000, among the Federal government, the Commonwealth of Puerto Rico, and the parties responsible for the spill, resolved claims for natural resource damages and provided the Trustees with funding of \$9,688,563 for compensatory restoration projects. A Memorandum of Agreement among the Trustees allocates the damages recovered to restoration actions in three categories of injury – reef injury associated with the barge grounding; loss of beach recreational use; and loss of enjoyment of national historic site resources.

Following settlement, the Trustees are required to develop a Draft Restoration Plan and Environmental Assessment (Draft Plan) (NOAA, et al. 2006) for the natural resources and services that were affected by the spill and provide an opportunity for public input. To facilitate public review, the Trustees have created brief project synopses for use during public meetings as one means of informing the public about potential restoration actions being planned. Each summarizes a potential restoration project that the Trustees identified. The public is also encouraged to propose restoration projects and provide comments during the restoration planning phase. Those wishing more information should refer to the Draft Plan, which is available from the Trustees.

The amount of settlement funds as allocated by resource damage category are listed in Table 1-1. Interest accrued on the available money will be used for selected restoration projects, as appropriate.

Table 1-1. Settlement Funds

Resource Injury Category	Available Funds
Reef Injury	\$5,715,313
Recreational Beach Use and Injury	\$2,273,063
Lost and Diminished Human Use of the National Historic Site	\$1,493,604
Environmental Planning, Oversight and Administration	\$ 206,583
Total Funds	\$9,688,563

^a The original settlement included an additional \$2,811,437 that was awarded to cover assessment costs. Those monies were disbursed to the respective agencies as reimbursement for past expenditures. The funds shown in Table 1-1 are the net available funds that must be spent on each of the resource injury categories, pursuant to a Memorandum of Agreement between the Trustees.

Proposed projects are listed in Table 1-2 and synopses of the proposed projects are grouped by the three injury types in the ensuing chapters. After evaluating public input on the Draft Plan and any other projects that the public may propose, the Trustees will prepare a Final Plan incorporating public input. At that time, the proposed projects and budgets for individual projects will be adjusted to fit the available funds in each category. The Trustee representatives may be reached at addresses that are listed in the Draft Plan.

Table 1-2. Proposed Projects and Estimated Costs

Resource and Service Category with Funding	Proposed Projects	
	Estimated Cost*	Project Name
Reef Restoration • \$5,715,313 in Available Funding	\$5,062,121 ^a	Modular Reef Habitat Construction (Shallow Hard Bottom Project)
	Up to \$5,715,313	Reef Sedimentation Mitigation
	Up to \$5,715,313	Acquisition of Equivalent Lost Services
	\$565,000	Seagrass Restoration
Recreational Beach Use • \$2,273,063 in Available Funding	\$3,974,500 ^a	Acquisition of Lands for Conservation
	No cost determined	Improved Access to Public Beaches
	\$4,393,750 ^a	Improved Quality of Use of Public Beaches
Lost and Diminished Use of San Juan National Historic Site Resources • \$1,493,604 in Available Funding	\$196,594	Improve Coastal Promenade – Option 1, Non-Slip Surface Treatment
	\$205,318	Construct Water Battery Overlook – Option 2
	\$974,142	• Option 3, Extension from Water Battery Overlook to El Morro
	\$2,274,800	• Option 4, Extension from El Morro to San Juan Cemetery
	\$3,567,957	• Option 5, Extension from La Perla to Devil's Sentry
	\$1,889,056	• Option 6, Extension from Devil's Sentry to La Princesa
	\$1,363,666	• Option 7, Extension from La Princesa to the Capitol Plaza
	\$ 10,069,621	Extend Coastal Promenade (Subtotal Options 3 through 7)
	\$10,471,533	Improve & Extend Coastal Promenade – Grand Total for All 7 Options
	\$140,000	Restoration of El Morro Water Battery
	\$350,000	Clean and Stabilize Exterior Walls of Historic Site

^a Costs are in 2002 dollars, otherwise costs listed in Table 1-2 are 2005 estimates.

2. REEF RESTORATION PROJECTS

The Trustees are proposing four potential reef restoration projects for restoring or replacing comparable ecological services at locations near the grounding site that would compensate for the lost use of the reef structure following the grounding-induced injuries. Compensatory restoration would provide compensation for services that were lost following the incident and continued to be lost or diminished during the recovery of the injured resources.

For identifying compensatory restoration projects, the Trustees evaluated the suitability of nearby marine habitats to host reef restoration activities. Their analysis was based on the similarity of

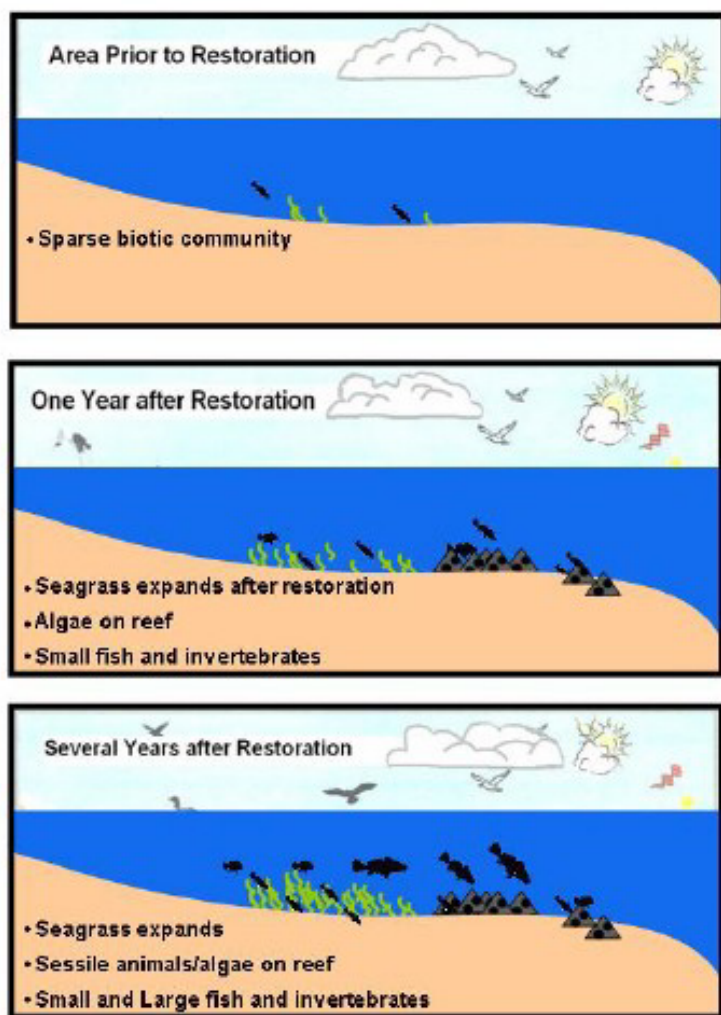


Figure 2-1. Schematic Representation of a Mosaic Restoration Area Prior to and Following Seagrass Restoration Coupled with Artificial Reef Creation

ecological functions provided by each habitat. A Habitat Suitability Analysis (MRI 2005) was performed using existing data sets compiled from the extensive regional literature and databases of marine species. That study ranked shallow hard bottom, seagrass, mangrove and deep hard bottom habitat in descending order of similarity to the injured reef. The injured reef was an eolianite reef which is an ancient fossilized sand dune system, submerged by rising sea levels and usually populated with both hard and soft corals, as well as other reef organisms. Factors of similarity included the numbers of eolianite reef species present and the ecological services provided. Based on that analysis, projects would offer opportunities of comparable value in restoring and replacing lost reef services if they were located in shallow hard-bottom habitats or in habitat mosaics where shallow hard-bottom is coupled with one or more other habitats, as illustrated in Figure 2-1. The four proposed reef projects in the summaries were developed in recognition of this benefits transfer technique.

While the Trustees have identified specific reef restoration projects in the course of conducting its restoration planning activities, as part of the public participation process, the Trustees welcome input on shallow hard bottom

projects or other restoration ideas. The Trustees will consider all projects with merit, and will make recommendations for a preferred alternative after systematically evaluating the identified alternatives.

2.1 Modular Reef Habitat Construction (Shallow Hard Bottom Project)

Project Description and Location

Trustees evaluated compensatory restoration alternatives consisting of placing prefabricated cement reef-replication modules in a shallow hard-bottom setting to create new habitat similar to the destroyed rock reef. Similar prefabricated reef modules have been used elsewhere in the United States to restore coral reefs impacted by vessel groundings. This alternative would consist of using established technology to construct and place cement reef-replication modules in a manner to provide a range of desirable ecological services. For example, a modular reef can be designed to maximize vertical profile, surface area for settling organisms, open-water and crevice-dwelling fish habitat, or some combination of ecological services. To develop a cost estimate for the constructed reef, the Trustees considered a number of prefabricated units that would be appropriate for the proposed site. The Trustees selected a reef design for costing purposes that combines low-profile and high-profile types of constructed reef units that have been installed elsewhere in the Caribbean and shown to be effective.



**Figure 2-2. Side View of Low-Profile Reef Module
from Florida Keys National Marine Sanctuary**

Figure 2-2 illustrates one type of artificial reef module that mimics a natural reef. The module, which is provided for illustrative purposes only, was constructed to repair a reef injury in the Florida Keys National Marine Sanctuary and was designed for both aesthetics and habitat function.

The project to construct and place cement reef-replication modules in a shallow hard bottom environment could be located in one or more favorable settings off the northern coast of Puerto Rico, where conditions for module placement and long-term stability are not as harsh as at the grounding site.

Background

The creation of an artificial reef that mimics low relief hard bottom community or coral reef is a compensatory habitat identified in the Habitat Suitability Analysis. A habitat creation project such as this would have multiple benefits if located in a widely accessible near shore area. For instance, an artificial reef would provide residents and visitors a unique opportunity to view and gain an understanding of some of the sensitive and valuable shallow water marine habitats as well as provide some amount of lost services and functions of that habitat.

To compensate for the loss of reef services, the Trustees propose constructing an appropriately scaled reef with placement offshore in water depths ranging between 5 and 30 meters (m) to replicate features at the grounding site. In the Trustees' judgment, the high wave energy and shallow water at the grounding site make construction there infeasible and expensive. The off-site constructed reef will provide reef services comparable to those lost, such as substrate for settlement and colonization by corals and other sessile reef biota, and suitable habitat for other organisms associated with the reef. The spatial scale of a shallow hard bottom project would be inversely proportional to the unit cost of the restoration technique. A more costly technique would result in a project of a smaller area.

Relationships to Injury Caused by the Grounding

The physical disruption of the reef had long-term impacts on its ecosystem. Prior to the grounding, the reef provided a stable, three-dimensional habitat for fish, shellfish, corals, algae, sponges, echinoderms, and many other types of organisms. The reef provided food, shelter, and breeding and nursery grounds for many organisms, and supported many recreational activities including sport fishing and diving. The reef also served as a natural breakwater, protecting the coastline during storms. All of these services were impaired by the grounding and subsequent response actions. The loss of vertical rock outcrops and other rocky substrates crushed by the grounding and the specific services associated with them are permanent losses.

The Trustees recognize that a shallow hard bottom replacement project could take any number of forms. The Habitat Suitability Analysis specifically identifies artificial reefs that are constructed to mimic natural hard bottom habitats and are located in a shallow hard bottom environment as potentially meeting the ecological service replacement objectives. It would provide even more replacement services if it is located proximal to one or more other habitats (i.e., mangrove, seagrass) where additional restoration could take place (Figure 2-1). This mosaic approach to siting and placement of reef structures near other habitats offers the opportunity to benefit juvenile and adult stages of species associated with the injured eolianite reef.

The Trustees will also consider alternative designs that meet the shallow hard bottom project objectives. For instance, the Trustees are aware of a stand of elkhorn coral (*Acropora palmata*) near the grounding site at Punta Escambron that might benefit from a restoration project. Although not considered in the Habitat Suitability Analysis, restoration of elkhorn coral may meet restoration objectives. So while the Trustees have made specific recommendations upon which they will base the preferred alternative, other shallow hard bottom project ideas are welcomed as part of the public participation process.

Project Cost and Schedule

The Trustees drew on experience and cost factors from comparable restoration and mitigation projects that have been conducted elsewhere in the United States and use similar prefabricated reef modules as a basis for estimating the costs to be approximately \$5,062,121. The estimate includes costs for site surveys, engineering designs, construction management, and fabrication and installation of modules. The personnel and most of the equipment needed to install the commercially available modules are readily obtainable in Puerto Rico. A project implementation timeline has not been determined at this time, but would be developed during the planning and engineering design phase of the project.

2.2 Reef Sedimentation Mitigation

Project Description and Location

The Trustees evaluated rehabilitating the "Submarine Gardens" natural reef offshore from Torrecillos Lagoon, which has been smothered by sediments produced by construction of a marina beginning in the 1940s. This alternative would include dredging to expose the rocky reef substrate and disposal of the sediment cover, which would eventually lead to re-colonization by typical reef organisms. The alternative would also require additional measures to contain and manage sediment loads so that future re-sedimentation could be prevented.

This project to exhume and restore an existing natural reef, "Submarine Gardens," which has been almost completely buried by sediments, is located approximately 7-10 miles east of the barge grounding site, close to shore off Torrecillos Lagoon.

Background

This alternative would consist of rehabilitating an existing natural reef that has been almost completely buried by sediments, as a result of a man-made marina and associated channels. The Submarine Gardens was a popular recreational diving spot for Puerto Ricans before the demise of the reef. This alternative could benefit numerous natural resources in the same way as construction of a modular reef, and it would pose the same public safety issues as a new reef. However, resource managers for Puerto Rico judge that containment of the sediment load would be an ongoing, labor-intensive project, with associated high but unpredictable costs. The potential success of this project may have some uncertainty, because of both the difficulties in containing sediments and the unpredictability of recovery of the long-buried reef. Collateral resource injury could be expected from dredging and disposal of sediments.

Relationships to Injury Caused by the Grounding

Restoration of this impaired reef structure would potentially produce similar ecological services as the lost reef structure at the grounding site. This alternative could benefit numerous natural resources in the same way as construction and deployment of a modular reef.

Project Cost and Schedule

No detailed costs or timeframe have been determined yet for this project. Consequently for this synopsis, the available funding for the reef restoration category, \$5,715,313, is used as a maximum allowable amount for this action; although the Trustees could choose to utilize some smaller proportion of the available funding to mitigate sediment in a part of Submarine Gardens while at the same time spending the remainder of the reef restoration funds on other projects. The categories of cost typically associated with sediment dredging projects include site surveys, engineering designs, construction management, dredging and disposal of the sediment cover, and measures to mitigate or prevent resedimentation.

2.3 Acquisition of Equivalent Lost Services

Project Description and Location

This compensatory project entails acquisition, preservation, and enhancement of coastal habitats that provide comparable and similar services to the lost reef resources. At this time the Trustees are only able to discuss an acquisition strategy and the relative types of project benefits and features because of the sensitivity of the potential land transaction process and related due diligence activities. However, the nature of the habitat types and the objectives of the acquisition process can be summarized.

The project could involve either single habitat categories or a mosaic of habitat types, dependent upon the timing of those habitats that are available for acquisition. Habitat types for consideration could include shoreline habitats, with adjoining submerged lands such as mangrove, seagrass, or some combination of desirable habitats.

Careful selection of an acquisition parcel may result in preserving services of other sensitive habitats. For instance, if seagrass habitat is close to mangroves, some of the protection offered by acquisition will extend to the adjacent seagrass habitat. In this manner, existing seagrass habitat services are protected from development in the same manner as mangroves. Likewise, the secondary effects of development, such as increased motor vessel traffic, demand for docks and boat slips, and dredging for vessel access, are eliminated as threats. While an acquisition strategy does not yield net increases in services, it does preserve and protect existing habitats from development losses. As future funding opportunities present themselves, additional enhancements may also be made on any acquired parcels.

Background

One means of compensating the public for the reef injury is through acquisition of equivalent resources or services (i.e., through property acquisition). For property acquisition to be considered a viable restoration alternative, the property should, at a minimum, contain one or more of the habitats demonstrated in the Habitat Suitability Analysis (MRI 2005) as capable of providing habitat services to those natural resources that utilize eolianite reefs. Types of habitats would include, but are not limited to, eolianite reefs, coral reefs (patch or fringing), seagrass beds, hard bottom/soft coral communities, and mangroves and mangrove lagoons.

In addition to habitat services, the Trustees identified other features that would support the selection of a property acquisition alternative. Properties containing scarce habitat like tropical wetland forest, such as *Pterocarpus officinalis* forests (also known as bloodwood or chicken tree (*Palo de pollo*) (UPR 2006)), or that support rare, threatened or endangered species would be strongly favored. Similarly, properties containing important ecological values, whether because of size, habitat composition, or geographic location would be considered important factors. Also, properties that have the potential to meet multiple restoration objectives, such as increasing public access to beach and dune habitats for recreation, conserve settlement funds by reducing restoration transaction costs. When evaluating individual properties, the trustees would consider the likelihood that future development will reduce or eliminate the natural resources and services associated with that property. Properties not threatened by development are less likely candidates for acquisition.

Mangrove habitat acquisition was identified as the major component of this alternative for reef restoration for many reasons. Coastal mangrove habitat is becoming scarcer due to development. Lands under government management or lands protected from development through conservation easements may be currently available for restoration, but private lands not under such protections are likely to be forever unavailable for acquisition or restoration once developed. The opportunity to restore mangrove habitat assumes land is available in the first place. The Trustees would prefer to protect a parcel of land under threat of development and preserve the ecological services currently provided by that habitat rather than undertake a smaller, but just as expensive, restoration project to replace the lost habitat services.

Other habitats, in addition to mangrove and seagrass habitats, will be considered when evaluating potential acquisitions. For example, beach and dune habitat, important to sea turtle nesting, may play a role in determining which properties are considered for acquisition.

Relationships to Injury Caused by the Grounding

This alternative would consist of substituting wetland habitat services, such as mangroves or seagrass habitats, for the services lost from the injured reef. This would require selecting a common metric (something that can easily be measured) such as fish production to characterize services provided by the different habitats, in order to determine the appropriate scale of a compensatory restoration project. The Habitat Suitability Analysis (MRI, 2005) ranked mangrove habitat as the second-most similar habitat to the injured eolianite reef, second only to shallow hard-bottom, based upon its great similarity in herbivore species. Seagrass habitat was ranked third overall, and was identified as an important recruitment habitat. The difference between mangrove and seagrass was relatively minor and both were considered similar in terms of habitat replacement potential. Benefits of habitat acquisition can be coupled with restoration gains from other projects such as shallow hard bottom modular reef habitat construction by careful placement and selection of both types of restoration alternatives.

Project Cost and Schedule

No costs or timeframe have been determined yet. Consequently for this synopsis, the available funding for the reef restoration category, \$5,715,313, is used as a maximum allowable amount for a coastal habitat acquisition, preservation, and/or enhancement project or a series of projects. However, the Trustees could choose to utilize some smaller proportion of the available funding for habitat acquisition, while at the same time spending the remainder of the reef restoration fund allocation on other compensatory restoration projects. Furthermore, because there are incentives in the natural resource damage assessment and restoration process for the Trustees to seek out other sources of funding or in-kind contributions from partnering organizations, the funds that the Trustees could allocate for this project may only reflect a portion of the total acquisition costs of any particular parcel or parcels of land. The balance of funding would come from outside sources or allied natural resource partners.

2.4 Seagrass Restoration Project

Project Description and Location

This compensatory project entails the beneficial use of dredged marine sediments from San Juan Harbor's maintenance dredging activities to fill dredge holes within the Condado Lagoon, approximately 1 mile southeast of the barge grounding site.

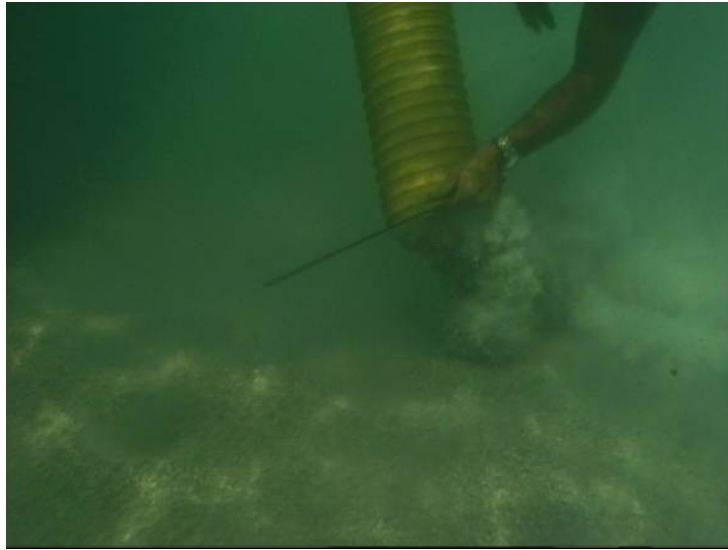


Figure 2-3. Fill Being Deposited in a Blowhole using a Large-Diameter Flexible Hose



Figure 2-4. Example of Fill in a Blowhole that Is Level and Up to the Surrounding Grade

According to a Preliminary Restoration Plan prepared by U.S. Army Corps of Engineers in March of 2003, an area totaling approximately 32 acres would be filled from a maximum depth of 35 feet to a maximum depth of 15 feet. This reduced depth would facilitate increased water flow and flushing, increased light reaching the seafloor and increased dissolved oxygen levels, as well as other benefits. Figure 2-3 illustrates one technique for managing the sediment filling process on similar depressions that resulted from vessel groundings called 'blowholes.' Once these dredge holes or blowholes are filled to grade and leveled, natural seagrass recovery and plant succession can be allowed to proceed unassisted. Figure 2-4 provides an example of what a blowhole looks like after sediment fill is placed.

An additional option exists to promote a more rapid recovery by planting bundled units of fast growing seagrass species (i.e., *Halodule wrightii* or *Syringodium filiforme*) within the filled area. Success will be favored in areas not currently experiencing loss of seagrass cover and of relatively low levels of wave and current energy. Figure 2-5 illustrates a seagrass planting unit that is going to be transplanted onto the surface of a sediment-filled hole to jumpstart the propagation of seagrass.



Figure 2-5. Example of a *Syringodium filiforme* (Manatee grass) Planting Unit

Background

Holes created as a result of dredging or blowholes caused by vessel groundings and recovery can offer ideal opportunities for the restoration of seagrasses to the seafloor. Restoration efforts in the Florida Keys National Marine Sanctuary and Biscayne National Park, Florida, have demonstrated that by filling holes with native sediments similar to surrounding types, can speed up the natural recovery of seagrasses. The process is simple; and this method has been tested, published and put into successful practice in tropical Atlantic systems using the same species as found in Puerto Rico (see Trustee Representatives for documentation and references).

Letters of support for the project have been written from the Commonwealth of Puerto Rico and the San Juan Bay Estuary Program. This

plan is also in agreement with published, tested methods from National Oceanic and Atmospheric Administration's seagrass restoration projects.

Relationships to Injury Caused by the Grounding

This alternative would consist of creating and restoring habitat services in a seagrass habitat for the services lost from the injured reef. The Habitat Suitability Analysis study that the Trustees undertook in 2005 (MRI 2005) ranked seagrass habitat as the third-most similar habitat to the injured eolianite reef; third only to shallow hard-bottom and mangrove habitat, based upon its similarity in herbivore species. Seagrass habitat was also identified as an important recruitment habitat, an added benefit. The difference between second-ranked mangrove and third-ranked seagrass was relatively minor, and both were considered similar in terms of habitat replacement potential by the conclusions of the Habitat Suitability Analysis (MRI 2005). Benefits of seagrass restoration can be coupled with restoration gains from other projects such as shallow hard bottom modular reef placements.

Project Cost and Schedule

The U.S. Army Corps of Engineers would implement the project as part of the San Juan Harbor Maintenance Dredging using its authority under Section 204 of the Water Resources Development Act of 1992. The Trustees would use settlement funds to pay the Sponsor cost of the project, a 25% non-federal cost share. The Sponsor cost is \$565,000.00 of the total project cost of \$2,260,000.00.

3. BEACH RESTORATION PROJECTS

Approximately 169 miles of coastal shoreline and embayments along the northern coast of Puerto Rico were affected by the Morris J. Berman oil spill. Oil from the spill contaminated many of the recreational beaches in this area during the height of the 1994 winter tourist season. Shoreline cleaning operations were extensive and lasted until April 8, 1994 on beaches near the grounding site. In the immediate vicinity of the spill, the *de facto* beach closings lasted three months, while at many of the more distant beaches, field operations were reduced or halted 5 or 6 weeks after the spill. Tourists and resident beach users were advised to avoid beaches in the spill zone, and cleanup activities essentially closed many popular beaches for an extended period following the spill. Prospective users of affected beaches may have canceled trips to Puerto Rico and/or the beach altogether or may have substituted with second-best alternative sites outside the spill zone. Other beach users continued to visit oiled beaches and may have suffered a loss of enjoyment, especially swimming, due to the oil. In addition, bathing suits and beach gear were damaged, and oil fumes caused headaches and nausea to some beach users. Furthermore, due to the presence of oil cleanup crews and equipment, *de facto* closings occurred at many beaches. In many cases, exclusion tape closed access to beach sites, and security personnel only allowed cleanup crews onto the beaches. Furthermore, many hotels along the affected beaches reported transporting hotel guests to beaches distant from the oil impact area. The causal link between these injuries and the incident was verified by documenting the presence of oil, response teams, and/or exclusionary barriers on the beaches.

The Trustees are required to consider implementing compensatory restoration actions to replace interim losses associated with an oil spill, and to the extent practicable, identify alternatives that provide replacement services of the same type and quality, and of comparable value, as those lost as a result of the incident. The Trustees were unable to identify feasible restoration alternatives that would have provided additional beach user-days. In this circumstance, the Trustees are allowed to consider alternatives that will provide replacement services of comparable type and quality, and of comparable value, as those lost.

As described above, the injury to recreational beaches and the lost use of these resources was documented to be three-fold – 1) lost use of the beach, 2) a diminished quality of those beach visits taken during and immediately after the spill response, and 3) increased costs associated with those visits taken. Consequently, the Trustees have identified three types of compensatory restoration projects to address these types of losses of recreational beach use. The project types include acquisition of lands for conservation, improved access to public beaches, and improved quality of use of public beaches

3.1 Acquisition of Lands for Conservation

Acquisition of lands for conservation as a compensatory project would involve acquiring coastal habitats that provide comparable, similar services to the lost recreational beach use. At this time the Trustees are only able to discuss an acquisition strategy and the relative types of project benefits and features because of the sensitivity of the potential land transaction process and due diligence activities.

Relationships to Injury Caused by the Spill

For this incident, the Trustees were unable to identify feasible restoration alternatives that would have provided additional beach user-days. Alternatively, the Trustees attempted to find alternatives that provided replacement services of the same type and quality, and of comparable value, as those lost as a result of the incident. In this circumstance, the natural resource damage assessment regulations allow Trustees to consider alternatives that will provide replacement services of comparable type and quality, and of comparable value, as those lost. In this case the value of the lands proposed for acquisition equates to the value of the lost beach use, and the replacement services of the acquired lands will be of comparable type and quality. Consequently, this project alternative will have a multifaceted beneficial impact on an extremely important natural ecosystem and popular recreational area that is located near to the beaches on the northern coast of Puerto Rico that were affected by the incident. The acquisition of conservation lands for recreation addresses public coastal recreation in the area affected by the oil spill incident, and helps to preserve existing natural resources, and contributes to making the public whole for losses suffered.

Project Cost and Schedule

No timeframe has been determined yet, and the costs shown are for a potential land acquisition that was previously evaluated during claim preparation. The costs shown in Table 3-1 for this synopsis illustrate the cost breakdown and the scale of typical cost categories for acquiring coastal land parcels. The estimated costs in this particular scenario currently exceed the recreational beach use restoration category allowance. As a consideration of the funding limitations, the Trustees could choose to utilize some smaller proportion of the available funding for land acquisition while at the same time spending the remainder of the recreational beach use restoration fund allocation on other restoration projects. Furthermore, because there are incentives in the natural resource damage assessment and restoration process for the Trustees to seek out other sources of funding or in-kind contributions from partnering organizations, the funds that the Trustees could allocate for this project may only reflect a portion of the total acquisition costs of any particular parcel or parcels of land, with the balance of funding coming from outside sources or allied natural resource partners. The categories of cost typically associated with land acquisitions are shown in Table 3-1 as an example of a cost breakdown.

Table 3-1. Typical Costs for Land Acquisition for Conservation

Category	Cost
Land Purchases (2,660 acres)	\$3,782,500
Title Searches (\$1,000/farm)	\$8,000
Appraisal Costs (\$3,000/farm)	\$24,000
Survey Costs (approximately \$57/acre)	\$151,000
Administration Costs (\$3,000/year, 3 years)	\$9,000
Subtotal	\$3,974,500

^a The estimated cost for this potential acquisition exceeds the allocated funding for lost beach use compensatory restoration. Consequently, the Trustees could choose to acquire a smaller acreage, acquire less costly lands in another location, or to pool these funds with other funding sources to conduct such an acquisition.

3.2 Improved Access to Public Beaches

Project Description and Location

This compensatory project would improve the quantity, quality, and availability to the public of coastal areas in Puerto Rico by completing feasible actions that the government has identified to improve access to beaches currently ranked as non-accessible beaches.

The Commonwealth of Puerto Rico identified and ranked numerous non-accessible beaches that would be candidates for improving public access. However, none of the identified, priority beaches is located within the coastal region directly affected by the oil spill; and the Trustees determined that the available priority projects were too far removed from the area impacted by the spill on Puerto Rico's north coast.

Background

The Trustees evaluated the results of a 1980s study of the quantity, quality, and availability to the public of coastal areas in Puerto Rico. The study identified major problems with access and use, suggested feasible actions the government could take to improve public use, and ranked non-accessible beaches in priority order for action.

Relationships to Injury Caused by the Spill

Access to many public beaches was impeded by the spill and the cleanup actions during the response to the spill. However, none of the identified, priority beaches with major access problems is located within the coastal region affected by the oil spill; the Trustees determined that the available priority projects were too far removed from the area impacted by the spill to be truly compensatory to the public.

Project Cost and Schedule

The costs and timeframe for improving beach access were not investigated, as the Trustees determined that the available priority projects were too far removed from the area impacted by the spill to be truly compensatory to the public. Consequently, costs were not determined.

3.3 Improved Quality of Use of Public Beaches

Project Description and Location

This compensatory project proposed by the Trustees includes implementing a series of improvements previously identified by other organizations that would address restoration of desirable beach features and natural resources as well as needed additions or enhancements to visitor amenities on existing public beaches. More specifically, the project involves re-vegetating 25 miles of beach uplands, constructing walks, decks and maintenance areas, and installing garbage stations. The series of improvement types that comprise this project alternative could be carried out at many of the same beaches along Puerto Rico's north coast that were affected by the oil spill.

Background

The Trustees evaluated the applicability of funding existing public beach management and improvement plans developed by the Commonwealth of Puerto Rico Coastal Zone Management program as compensatory restoration alternatives. These plans discuss improvements to beach resources such as reforestation or revegetation as well as additions or enhancements to visitor facilities such as walkways, decks, maintenance areas, and garbage stations on beaches. Many of these activities are proposed for the same beaches affected by the oil spill. These projects are expected to enhance the value of existing use of beaches, rather than increase beach use.

Relationships to Injury Caused by the Spill

The improvements would be proposed for the same beaches affected by the oil spill as a means of enhancing the value of existing beach use, rather than increasing beach use, which was the largest injury caused by the spill. While the location of the projects would be at the formerly impacted beaches, the relationship of these improvement projects as compensation for the impacts from the spill incident is less certain than natural resource protection.

Project Cost and Schedule

The costs of projects designed to improve the quality of use of the beaches affected by the incident vary according to the items included in a proposed package. Administrative costs -- planning and design, and the costs of upkeep -- would have to be added to these estimates. The estimated total costs of \$4,393,750 for all of the improvement projects identified by the Coastal Zone Management Program currently exceed the allocation for this restoration category. Each project category identified in Table 3-2 can be implemented independently, either partially or in whole, so the Trustees would have some latitude in carrying out beach use quality improvements as a component of restoration for lost or diminished beach use. No schedule or timeline has been determined yet, but they would be developed as part of the planning and design phase of this type of project.

Table 3-2. Estimated Costs of Projects to Improve Quality of Beach Use

Category	Cost
Revegetation of 25 miles of beach uplands	\$2,331,250
Construction of walks, decks and maintenance areas	\$1,500,000
Costs of constructing garbage stations	\$562,500
Planning and design; costs of upkeep	Not determined
Subtotal Cost	\$4,393,750

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4. PROJECTS TO COMPENSATE FOR LOST AND DIMINISHED USE OF NATIONAL HISTORIC SITE



Figure 4-1. Layout of Features at San Juan National Historic Site and Old San Juan



Figure 4-2. Oblique Aerial View of Old San Juan

The Trustees are proposing three projects for San Juan National Historic Site (Figures 4-1 and 4-2) related to compensation for lost visitor use caused by the spill. The three proposed alternatives are, in priority order, improving and extending the Coastal Promenade, restoring the El Morro Water Battery (also known as the Floating Battery), and cleaning and stabilizing the exterior wall of El Morro. Figure 4-3 shows the Coastal Promenade (Phase I) as well as the El Morro Water Battery and the exterior wall areas that are to be improved under the proposed alternatives. A Beach Erosion Mitigation project (construction of breakwaters to protect Fort El Canuelo), a fourth project defined in the Damage Assessment Restoration Plan, is now considered unnecessary (based on a U.S. Army Corps of Engineers' analysis) because shoreline erosion has slowed and is no longer a serious threat.



Figure 4-3. Phase I Coastal Promenade, Water Battery, and Wall Area Proposed for Improvement

4.1 Improvements to and Extension of Coastal Promenade

Project Description and Location

The Coastal Promenade Project, originally defined during the damage assessment, consists of two phases. Phase I, constructing the promenade from the San Juan Gate to the Water Battery (see Figures 4-2, 4-3) has been completed. Phase II, which involves improvements to and extension of the existing Promenade is now being proposed as the first priority project for the Berman restoration. It consists of the seven options described below (see Figures 4-3, 4-4):

- Option 1, Apply Non-slip Surface Treatment on the Existing Walkway
- Option 2, Extend Promenade and Construct a Water Battery Overlook
- Option 3, Promenade Extension from the Water Battery Overlook to El Morro
- Option 4, Promenade Extension from El Morro to San Juan Cemetery
- Option 5, Promenade Extension from La Perla to Devil's Sentry
- Option 6, Promenade Extension from Devil's Sentry to La Princesa
- Option 7, Promenade Extension from La Princesa to the Capitol Plaza

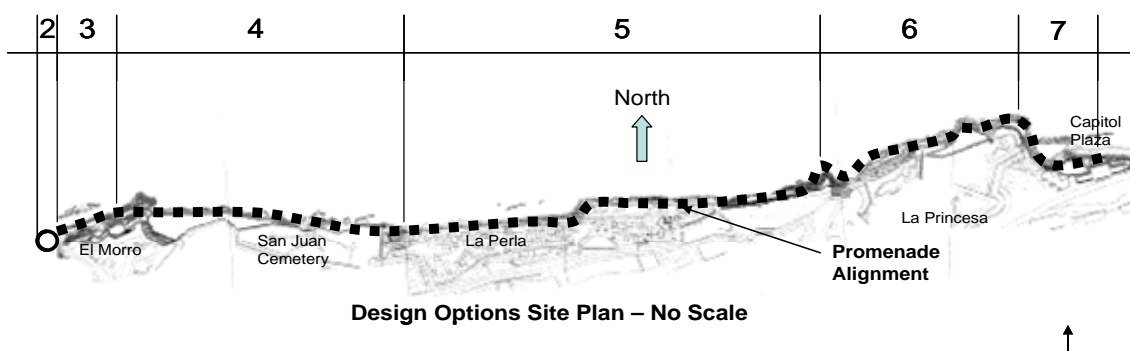


Figure 4-4. Coastal Promenade Phase II

Options 1 and 2 may be implemented individually and separately. They are higher priorities than Options 3 – 7, which can only be implemented sequentially starting at Option 3. The current Promenade, to be improved in Option 1, is located on the west side of El Morro (Figures 4-2 and 4-3). The Water Battery Overlook and Promenade extensions would be located on the shoreline north of El Morro and Old San Juan in an area directly impacted by the spill (Figure 4-4). The total Phase II project would extend this coastal trail around the Old San Juan Historic Wall and San Juan Islet to access the historic city walls and El Morro and its grounds.

Option 1: Treat Existing Walkway with a Non-slip Surface

Option 1 would apply a non-slip treatment to the entire existing walkway and install trench drains across the walkway in low areas where water collects to alleviate periodic unsafe, slippery conditions.

Option 2: Construction of a Water Battery Overlook

Option 2 would extend the Promenade at the Water Battery in a circular manner and center the overlook on the existing stone seat wall (Figure 4-5). Other features include concrete bollards, low-level walkway lights, rip-rap, a drinking fountain, and interpretive signage.



Figure 4-5. Close-up of Existing Stone Seat Wall and Bollards at the “Floating Battery”



Figure 4-6. View to the East at the End of the Promenade



Figure 4-7. View to the East across the Cemetery

Option 3: Extension of the Promenade from the Water Battery to El Morro

Option 3 would extend the Promenade from the Water Battery approximately 300 feet east along the base of the fort to connect with an existing stairway (Figure 4-6) to access the upper levels of El Morro. Other features include lighting for night use, reinforcement of the El Morro wall, protective rip-rap, and landscape improvements.

Option 4: Extension of the Promenade from El Morro to San Juan Cemetery

Option 4 would extend the Promenade from the end of Option 3 east along the base of El Morro past the San Juan Cemetery (Figure 4-7). There it would connect to a new stairway that would link the Promenade with San Juan Boulevard in the community of La Perla. Stairway construction would incorporate retaining walls to protect against erosion that now threatens to undercut the roadway and cemetery. Other features include wayside exhibits with information on the history of the cemetery and La Perla.

Option 5: Extension of the Promenade from La Perla Community to Devil's Sentry

Option 5 would extend the Promenade east from the Option 4 stairway until it connects with Calle San Miguel, where it would run on the sidewalk and street pavement through La Perla (Figure 4-7). Continuing east, the walkway would parallel the shoreline to connect with the existing path leading to the Devil's Sentry. Other features would include landscaping, rip-rap, revegetation, and a wayside exhibit near Devil's Sentry.

Option 6: Extension of the Promenade from Devil's Sentry to La Princesa

Option 6 would continue east from Devil's Sentry to the base of La Princesa, a stone battery located at the east end of San Cristobal (Figure 4-7). From the end of Option 5, the walkway will lead down to the base of Devil's Sentry, cut across the existing rip-rap slope and connect to the existing concrete walkway along the water's edge, where it

would follow the shoreline up to the base of La Princesa. Construction of Option 6 would be more difficult to build than the other options because of the rugged terrain and technical challenges.

Option 7: Extension of the Promenade from La Princesa to the Capitol Plaza

Option 7 would extend the Promenade to a termination point near the Puerto Rico Capitol. From La Princesa running easterly, the walkway would drop down to just above the shoreline and continue to a point below the pedestrian plaza across the street from the Capitol. A lighted stairway would connect the Promenade to the plaza following an existing dirt path. The shore in this area is a combination of sandy beach, native rock outcrops, and rip-rap. The terminus of the Promenade would be an excellent location for wayside exhibits describing the Promenade, the Capitol, the sea, natural forces along the coastline, or other pertinent themes.

Background

The Promenade, a National Recreational Trail, provides access to an area of the historic site adjacent to the coast. It enhances visitor appreciation of the forts, the city walls, and their historic settings as well as the natural resources along the shoreline. As a result of the restoration, now inaccessible natural areas with natural shorelines, vegetation, tide pools with sea life, and birds would become accessible and some resource protection features would be installed. The project would offer opportunities to view the geology of the area and experience the coastal and marine resources that gave the El Morro fortifications their strategic importance.

Relationship to Injury Caused by the Spill

The Trustees determined there was a reduction in historic appreciation services for approximately 6 weeks after the oil spill. During that time more than 123,000 people who visited El Morro and San Cristobal were impacted. The National Park Service also determined that some individuals may have canceled their visits to the park because of the spill. This interim loss of visitor use and enjoyment resulted in compensatory restoration. The Promenade Extension would provide replacement services of comparable type, quality and value as those lost because of the spill and the post-spill, response action. This compensatory restoration project would provide improved and safer access for future visitors to the shoreline at the historic site, where significant cultural and natural resources were directly impacted by the spill.

Project Cost and Schedule

Estimated costs for the project options are shown in Table 4-1. Estimates include construction costs plus 17 percent to design, 8 percent for construction management, and 10 percent for contingencies.

Table 4-1. Total Cost for Improvements to and Extension of Coastal Promenade

Option	Cost
Option 1, Non-Slip Surface Treatment	\$196,594
Option 2, Water Battery Overlook	\$205,318
Option 3, Promenade Extension from the Water Battery Overlook to El Morro	\$974,142
Option 4, Promenade Extension from El Morro to San Juan Cemetery	\$2,274,800
Option 5, Promenade Extension from La Perla to Devil's Sentry	\$3,567,957
Option 6, Promenade Extension from Devil's Sentry to La Princesa	\$1,889,056
Option 7, Promenade Extension from La Princesa to the Capitol Plaza	\$1,363,666
Total Cost	\$10,471,533

Estimates of the time to complete each option are shown in Table 4-2. The times shown for Options 1–3 are independent of each other, whereas those for Options 4–7 would be sequential. Thus, the completion time shown for each option includes the time for all other prerequisite options. More detailed construction schedules for all each of the various options would be developed in conjunction with the engineering/design package.

Table 4-2 Phase II El Morro Promenade Project Completion Time Estimates

Project Option	Estimated Completion Time (months)
Option 1, Non-slip Surface Treatment	2
Option 2, Floating Battery Overlook	3
Option 3, Floating Battery to El Morro	10
Option 4, El Morro to San Juan Cemetery	15 (includes Options 3 and 4) ^a
Option 5, La Perla to Devil's Sentry	25 (includes Options 3, 4, 5) ^a
Option 6, Devil's Sentry to La Princesa	36 (includes Options 3, 4, 5, 6) ^a
Option 7, La Princesa to Capitol Building	48 (includes Options 3, 4, 5, 6, 7) ^a

^a Time for completion of the associated option and all prerequisite options.

4.2 Restoration of El Morro Water Battery

Project Description and Location

This project, which was identified by the Trustees as the second priority at the historic site, would stabilize and preserve the historic interior and exterior surfaces of the Water Battery area and the adjacent exterior walls that face the shoreline ecosystem and recreational trails. The project would correct existing unsafe conditions resulting from hundreds of years of deterioration of the structures due to the tropical climate and wind and wave erosion. To perform the restoration, preservation teams on scaffolds will use low-pressure washing systems to clean the walls of vegetation and soil. Patches of inappropriate materials will be removed, cracks filled, and stucco replaced in-kind. The stairways will be repaired to allow access to portions of the battery now inaccessible to visitors. All restoration would follow recommendations of the historic site's "General Management Plan" and "Historic Structures Report."

The Water Battery, sometimes called the Floating Battery, is located along the natural shoreline of San Juan Bay at the northwest corner of El Morro (Figure 4-3).

Background

At the Water Battery, the National Park Service can interpret the cultural and historic resources and provide visitor access to the natural shorelines and recreational trails of the historic site. Although access to this area is now limited, the Water Battery still attracts thousands of visitors a year. Restoring the battery would repair historic resources that have been deteriorating for many years and allow safe visitor access to areas currently closed. Access to the Water Battery area would not only help visitors understand the strategic relationship between the historic site's defensive systems and the natural environment, but also provide an area that would allow interpretation of the shoreline ecosystem.

Relationship to Injury Caused by the Spill

The Trustees determined there was a reduction in historic site appreciation services for approximately 6 weeks following the oil spill. During that time more than 123,000 people who visited El Morro and San Cristobal were impacted. The NPS ascertained that other individuals may have canceled their visits to the park altogether because of the spill. This interim loss of visitor use and enjoyment of these resources resulted in compensatory restoration. Restoring portions of the Water Battery walls would provide replacement services of comparable type and quality, and of comparable value, with those lost during the spill and post-spill response actions. This compensatory restoration project would improve access to a portion of the historic fort that was directly impacted by the spill, where there is now limited access to significant cultural and natural resources.

Project Cost and Schedule

Restoring approximately 5,000 square feet of the walls of the El Morro Water Battery, which would be done by in-house staff, is estimated to cost \$140,000. The estimated time to complete the restoration of the El Morro Water Battery is 4 months. It is anticipated that lead time for commencing implementation would be relatively short because neither extensive designs nor plans are required.

4.3 Clean and Stabilize Exterior Walls of Historic Sites

Project Description and Location

This project, identified by the Trustees as the third priority project at the historic site, includes the cleaning, stabilization, and restoration of approximately 25,000 square feet of the exterior wall of El Morro adjacent to the Water Battery. Cleaning will be done using a mild, water-soluble solution applied with a low-pressure sprayer to remove environmental staining, vegetation and biological growth such as fungi and non-native seagrasses. Inappropriate patching material will be removed, cracks repaired, and deteriorated brickwork replaced. Deteriorated historic brickwork and masonry mortar will be replaced in-kind using a historic lime-based mortar.

The exterior walls of El Morro proposed for restoration are the west-facing walls located at the northwest corner of El Morro, adjacent to and just south of the Water Battery, sometimes called the Floating Battery (Figure 4-3).

Background

Biological growth and saltwater intrusion through exposed masonry threaten the long-term stability of the historic sites. By removing these threats, this restoration project would restore the historic walls providing the public with continued use and enjoyment of the structures.

Relationship to Injury Caused by the Spill

The Trustees determined there was a reduction in historic site appreciation services for a period of approximately 6 weeks following the oil spill. During that time more than 123,000 people who visited El Morro and San Cristobal were impacted. The National Park Service ascertained that other individuals may have canceled their visits to the park altogether because of the spill. This interim loss of visitors use and enjoyment of the resources resulted in compensatory restoration. Restoring portions of the walls of El Morro would provide replacement services of comparable type and quality, and of comparable value, with those lost during the spill and post-spill response actions. This compensatory restoration project would improve the long-term visitor appreciation for a portion of the historic fort that was directly impacted by the spill thereby ensuring that future visitors are afforded a view of walls that are more representative of historical conditions.

Project Cost and Schedule

The repair of approximately 25,000 square feet of exterior wall, which would be done by in-house staff, is estimated to cost \$350,000. The estimated time to complete the project to clean and stabilize the exterior walls of the historic sites is 6 months. It is anticipated that lead time for commencing implementation would be relatively short because neither extensive designs nor plans are required.

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5. REFERENCES

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